US005520064A

United States Patent [19]

Hickerson et al.

[11] **Patent Number: 5,520,064**

[45] **Date of Patent: May 28, 1996**

[54] **PORTABLE RESCUE TOOL**

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[21] Appl. No.: **410,817**

[22] Filed: **Mar. 27, 1995**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 289,842, Aug. 12, 1994, which is a continuation of Ser. No. 94,502, Jul. 20, 1993, abandoned, which is a continuation-in-part of Ser. No. 952,688, Sep. 29, 1992, Pat. No. 5,297,780.

[51] **Int. Cl.**[6] **B66F 3/00**

[52] **U.S. Cl.** ..... **74/421 R**; 192/20

[58] **Field of Search** ..... 74/421 R; 192/20; 901/38

[56] **References Cited**

U.S. PATENT DOCUMENTS

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5,297,780	3/1994	Hickerson	254/124

Primary Examiner—Dirk Wright
Attorney, Agent, or Firm—Klauber & Jackson

[57] **ABSTRACT**

A portable rescue tool which operates off electric power and which comprises a clutch mechanism for orienting high torque spreading and/or cutting motion that is produced by the portable rescue tool in a plurality of possible directions with respect to the portable rescue tool. The portable rescue tool comprises a rotary switch for controlling the operation of the portable rescue tool, a DC motor connected to the rotary switch for providing a high speed, low torque output, a gear reduction assembly coupled to the DC motor for decreasing the speed and increasing the torque of the DC motor output, an actuator assembly coupled to the gear reduction assembly for providing a low speed, high torque output, and a clutch mechanism associated with the actuator assembly for orienting the direction of the low speed, high torque output with respect to the portable rescue tool.

10 Claims, 6 Drawing Sheets

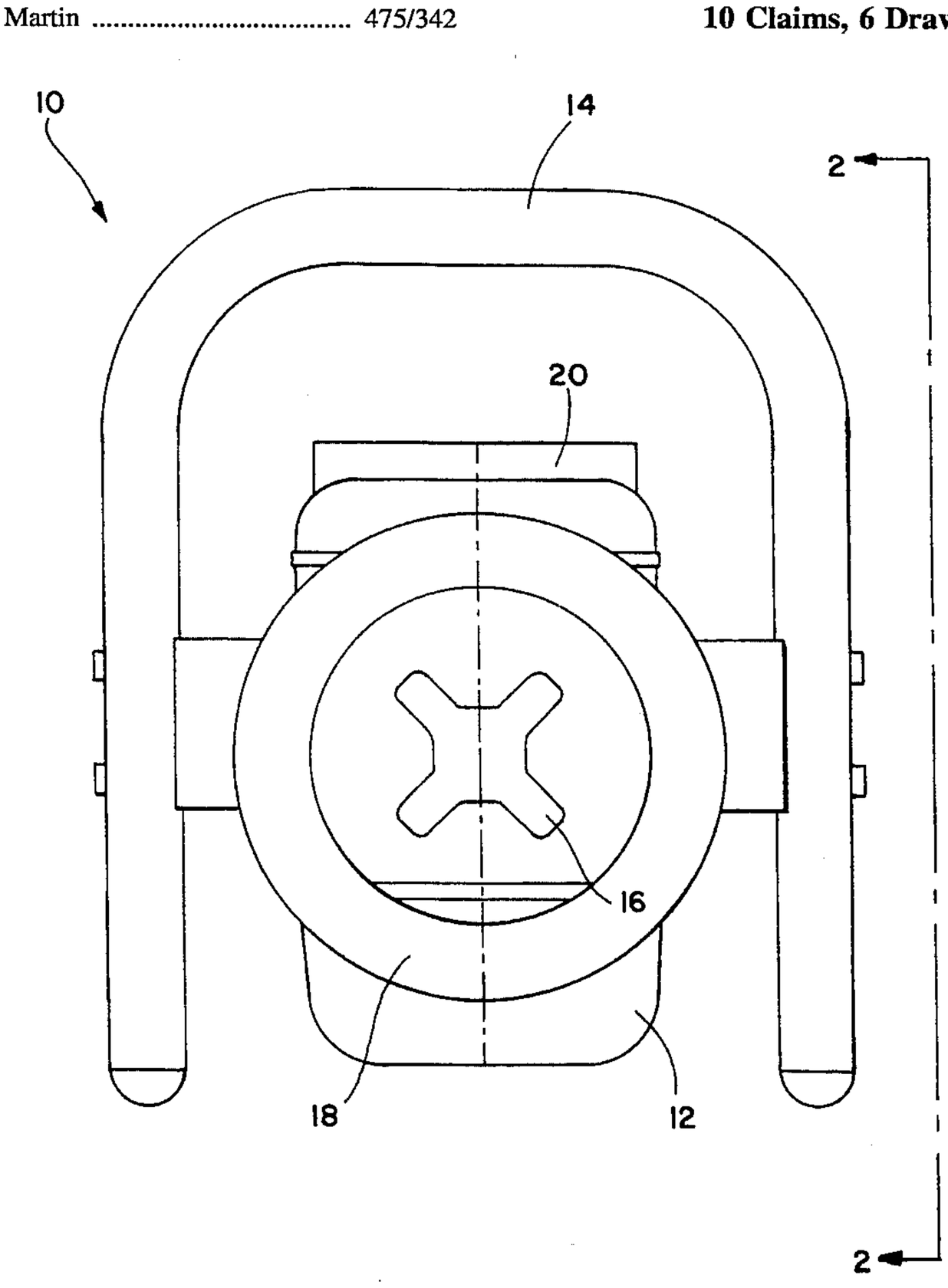
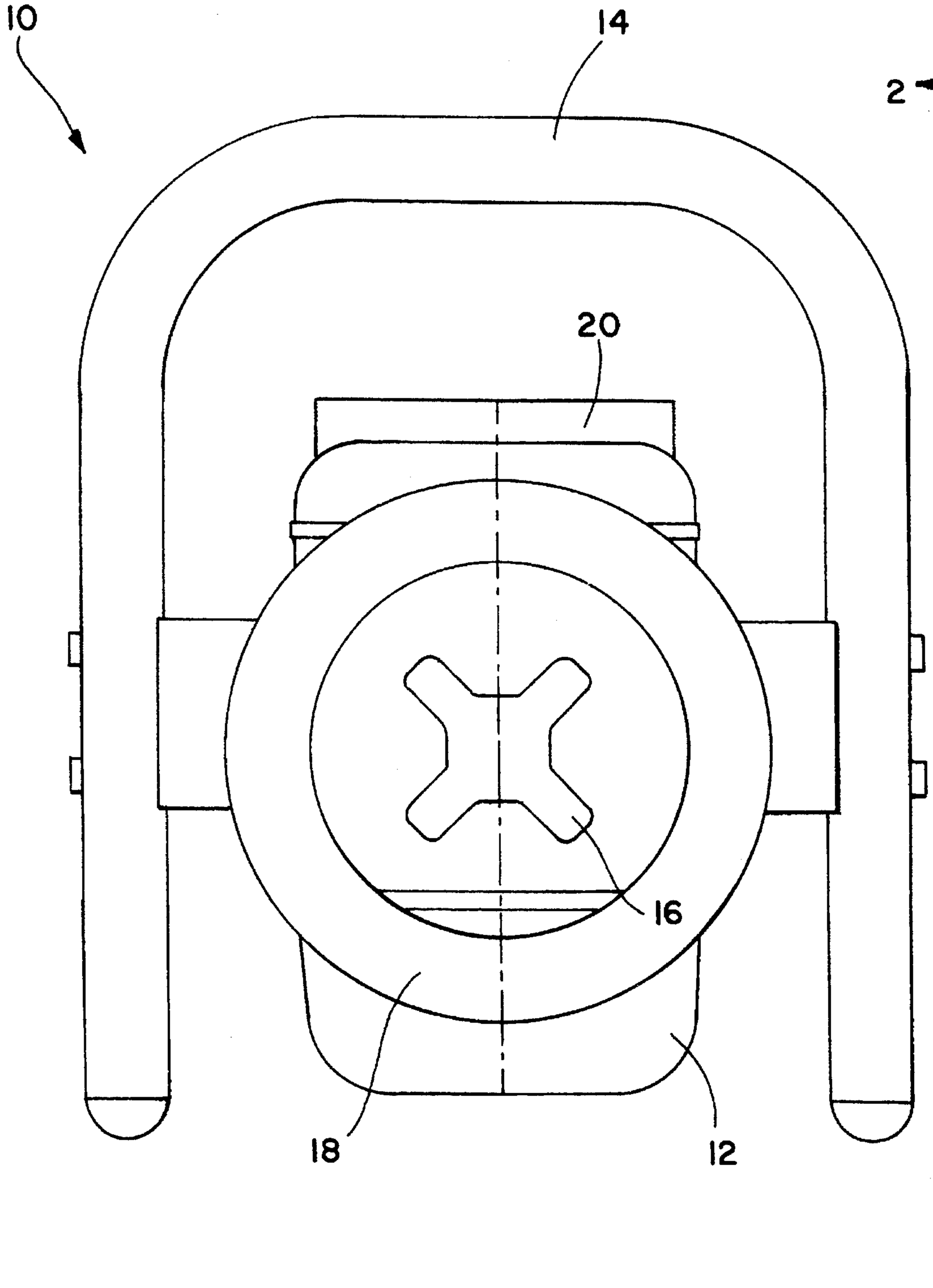


FIG. 1



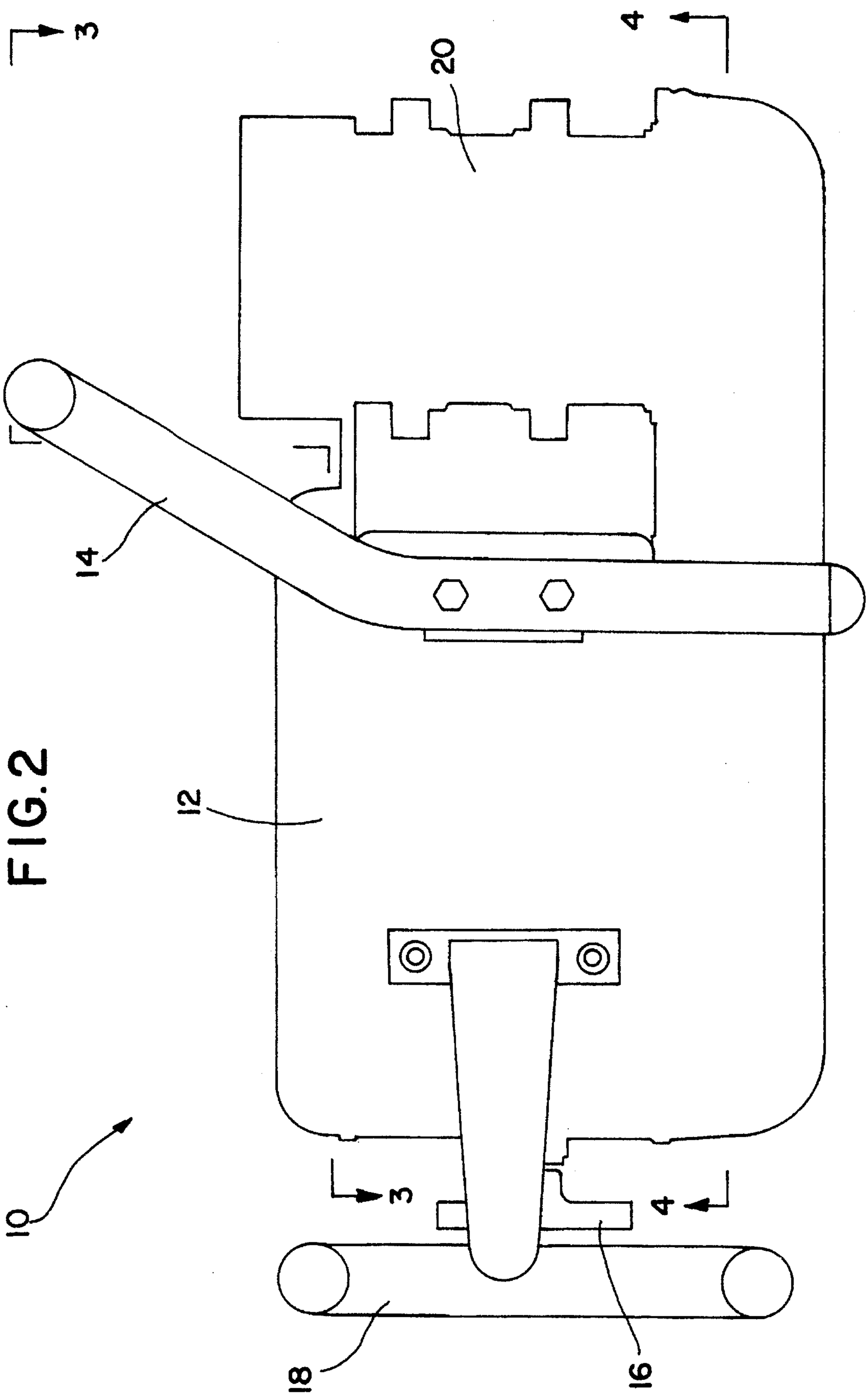


FIG.2

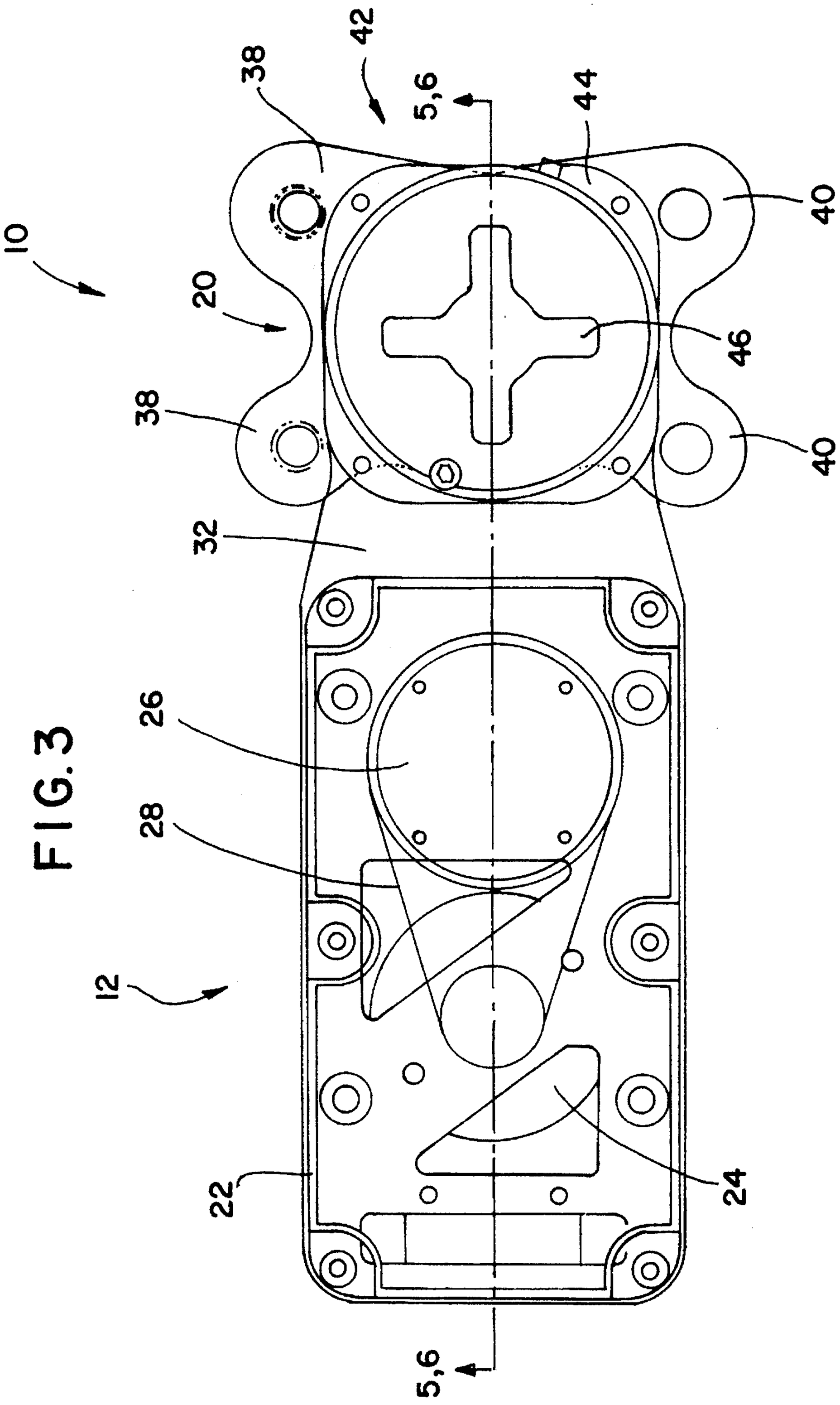


FIG. 3

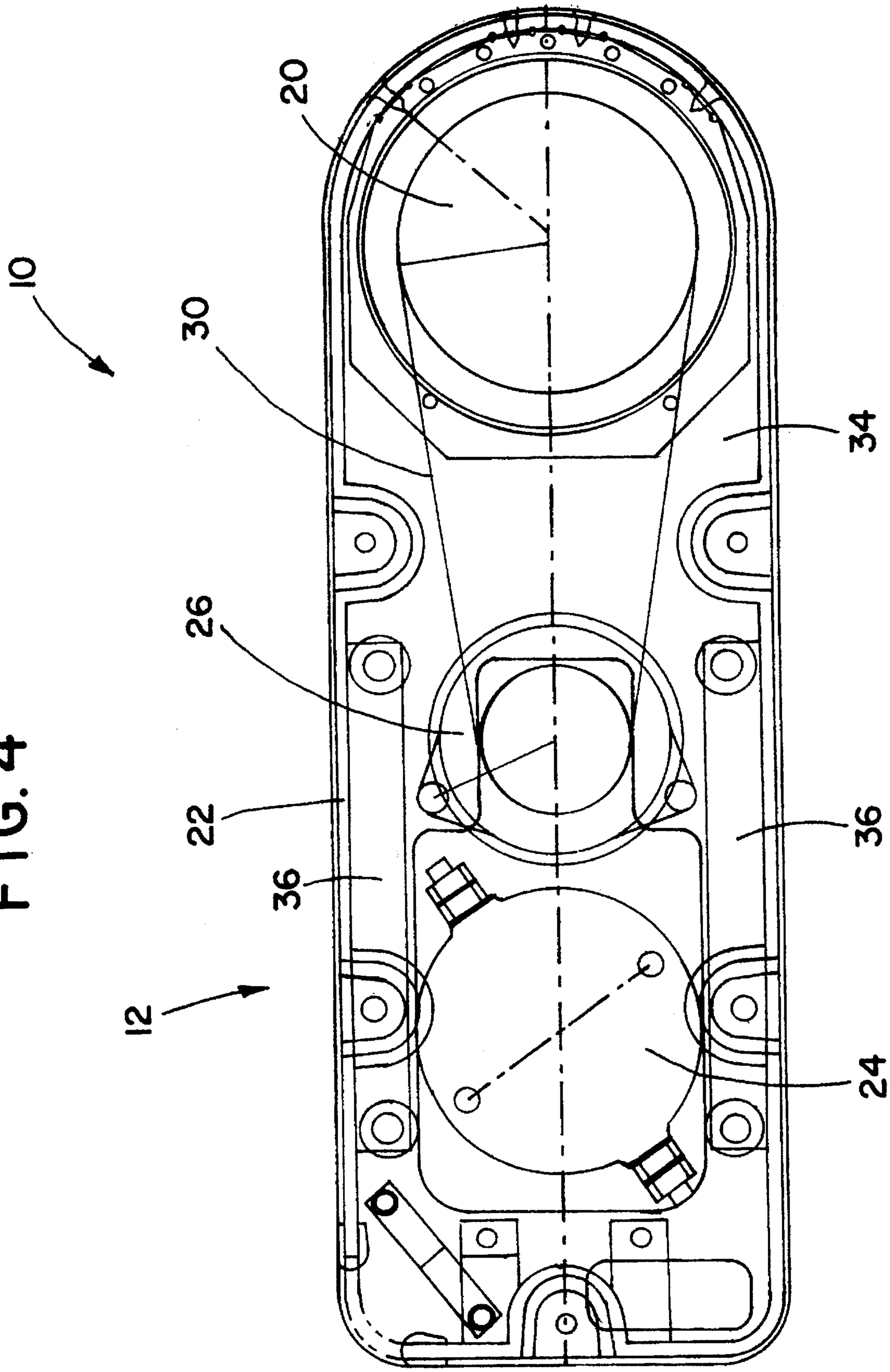


FIG. 4

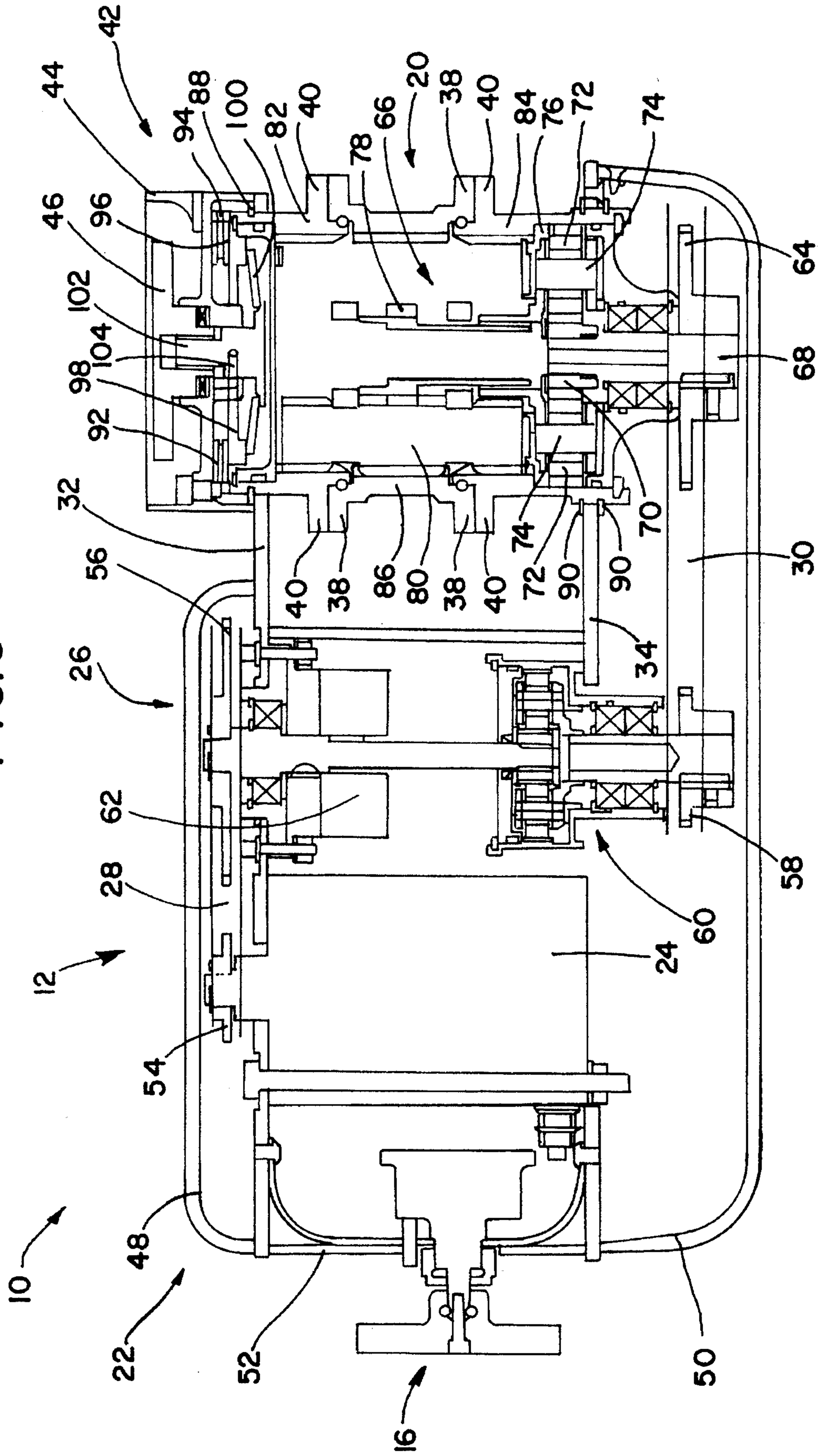

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FIG.5

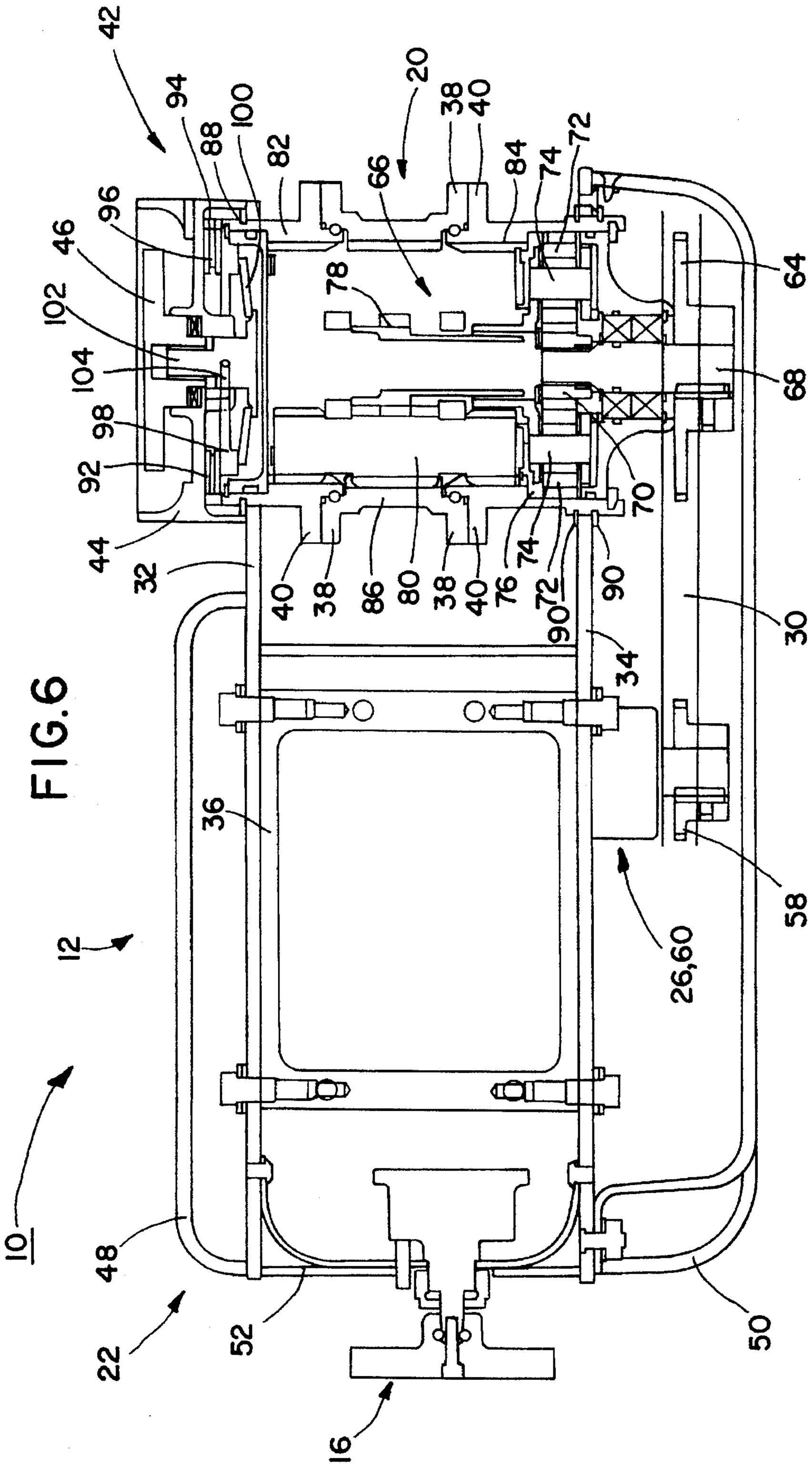
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FIG.6

PORTABLE RESCUE TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part application of file-wrapper-continuation application Ser. No. 08/289,842, which was filed on Aug. 12, 1994, which is presently pending, and which is the file-wrapper-continuation application of continuation-in-part application Ser. No. 08/094,502, which was filed on Jul. 20, 1993, which has been abandoned, and which is the continuation-in-part application of patent application Ser. No. 07/952,688, which was filed on Sep. 29, 1992, and which has been issued as U.S. Pat. No. 5,297,780.

FIELD OF THE INVENTION

This invention relates to portable devices which deliver spreading and/or cutting motion under high loads, and, more particularly, to a portable rescue tool having a clutch mechanism for orienting the spreading and/or cutting motion provided by the portable rescue tool in a plurality of possible directions with respect to the portable rescue tool.

BACKGROUND OF THE INVENTION

Rescue tools known as "Jaws of Life" (registered trademark) type devices are specialized tools used by various rescue personnel such as police, firemen, and paramedics generally for the purpose of extricating accident victims from vehicles whose exits have been rendered inoperable. These tools require spreading and closing forces for opening or ripping apart inoperable doors or for cutting through relatively thick metal layers. Pushing and pulling forces of 7,000 to 15,000 pounds at the tips of these tools are considered to be normal for the proper operation of such tools. In the past, in order to achieve such high forces, the tools have been almost exclusively hydraulic and powered by gasoline engines, for example as described in U.S. Pat. No. 4,842,249.

With self contained hydraulic and gasoline units, the tools are somewhat portable for use under the adverse conditions that are commonly encountered during the rescue of accident victims. However, many of these "portable" units weigh in excess of 200 pounds. Furthermore, many of these "portable" units require at least two persons for operation and/or transport since they have separated power and operation units.

Some tools, such as the ones described in U.S. Pat. No. 4,896,862, are designed as separate jaw elements for use with various available powered inputs such as pneumatic or hydraulic pumps or electric motors which drive threaded actuating elements. Though these tools, and others, are described as being powered by an electric motor, most devices are powered by gasoline or other fuel operated devices which provide the requisite driving power in a portable fashion. Electric power sources are not readily available in most emergency situations and portable batteries have not been considered capable of providing the requisite torque for effective operation of such devices.

As a result of the widespread use of hydraulic systems with fuel operated powering, as a general proposition, many of the existing tools also require constant costly maintenance of various components in order to maintain effectiveness.

The major drawbacks for most hydraulic system tools include the inability to generate full tip spreading force at the time of the initial spreading application, the time at which such forces are needed most. Also, gasoline powered hydraulic devices are very noisy and, because of fuel containment exigencies, require special transport compartments. Other major drawbacks of fuel operated power units include the detrimental susceptibility to environmental conditions including explosive atmospheres and inclement weather. A gasoline powered unit is dangerous to operate under many accident conditions, especially where speed is required in the act of saving one or more victims from the imminent harm of spreading flames.

In view of the above, it would be both novel and desirable to provide a portable rescue tool which operates off electric power and which comprises a clutch mechanism for orienting high torque spreading and/or cutting motion that is produced by the portable rescue tool in a plurality of possible directions with respect to the portable rescue tool.

SUMMARY OF THE INVENTION

The present invention contemplates a portable rescue tool which operates off electric power and which comprises a clutch mechanism for orienting high torque spreading and/or cutting motion that is produced by the portable rescue tool in a plurality of possible directions with respect to the portable rescue tool. The portable rescue tool comprises a rotary switch for controlling the operation of the portable rescue tool, a DC motor, connected to the rotary switch, for providing a high speed, low torque output, a gear reduction assembly, coupled to the DC motor, for decreasing the speed and increasing the torque of the DC motor output, an actuator assembly, coupled to the gear reduction assembly, for providing a low speed, high torque output, and a clutch mechanism, associated with the actuator assembly, for orienting the direction of the low speed, high torque output with respect to the portable rescue tool.

Accordingly, the primary objective of the present invention is to provide a portable rescue tool which operates off electric power and which comprises a clutch mechanism for orienting high torque spreading and/or cutting motion that is produced by the portable rescue tool in a plurality of possible directions with respect to the portable rescue tool.

Other objectives and advantages of the present invention will become apparent to those skilled in the art upon reading the following detailed description and claims, in conjunction with the accompanying drawings which are appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a fuller understanding of the present invention, reference is now be made to the appended drawings. The drawings should not be construed as limiting the present invention, but are intended to be exemplary only.

FIG. **1** is an end view of a portable rescue tool according to the present invention.

FIG. **2** is a side view of the portable rescue tool shown in FIG. **1** taken along line **2—2** of FIG. **1**.

FIG. **3** is a partial cross-sectional view of the portable rescue tool shown in FIG. **1** with the first handle removed taken along line **3—3** of FIG. **2**.

FIG. **4** is a cross-sectional view of the portable rescue tool shown in FIG. **1** with the first handle removed taken along line **4—4** of FIG. **2**.

FIG. **5** is a cross-sectional view of the portable rescue tool shown in FIG. **1** with the first and second handles removed taken along line **5—5** of FIG. **3**.

FIG. **6** is a cross-sectional view of the portable rescue tool shown in FIG. **1** with the first and second handles and the DC motor and gear reduction assembly removed taken along line **6—6** of FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1 and 2**, there is shown a portable rescue tool **10** according to the present invention. The portable rescue tool **10** comprises a main body **12**, a first handle **14** secured to the main body **12** for gripping the same, a rotary switch **16** secured to the main body **12** for controlling the operation of the portable rescue tool **10**, a second handle **18** secured to the main body **12** for also gripping the main body **12** and for protecting the rotary switch **16**, and an actuator assembly **20** operatively connected to the main body **12** for providing a low speed, high torque output for performing rescue tool functions.

Although not shown herein, rescue tool implements, such as spreaders and cutters, are removably connected to the actuator assembly **20** for actually performing rescue tool functions. Such rescue tool implements are described in detail in the file-wrapper-continuation application Ser. No. 08/289,842, which was filed on Aug. 12, 1994, and which is presently pending.

Referring to FIGS. **3 and 4**, there are shown a partial cross-sectional view and a cross-sectional view of the portable rescue tool **10**, respectively. In these views, the main body **12** is shown comprising a housing **22**, a DC motor **24** disposed within the housing **22**, a gear reduction assembly **26** also disposed within the housing **22**, a first chain **28** for operatively coupling the DC motor **24** to the gear reduction assembly **26**, and a second chain **30** for operatively coupling the gear reduction assembly **26** to the actuator assembly **20**.

A first (upper) plate **32** and a second (lower) plate **34** pass horizontally through the main body **12** and outward thereof. The upper and lower plates **32,34** are designed with cut-outs formed therein so as to mate with and allow the DC motor **24** and the gear reduction assembly **26** to be secured thereto within the housing **22**, and allow the actuator assembly **20** to be rotatably mounted thereto outside the housing **22**. The upper and lower plates **32,34** are fabricated of relatively high strength aluminum and are secured together by a pair of spacers **36**, which are also fabricated of relatively high strength aluminum, so as to provide strength and rigidity to the entire portable rescue tool **10**.

The actuator assembly **20** typically comprises a rotary, multiple stage gearbox having movable ring gear lugs **38** and fixed ring gear lugs **40** to which spreading and/or cutting arms are attached. A clutch mechanism **42**, comprising a clutch housing **44** and a clutch handle **46**, is utilized to orient and mount the actuator assembly **20** in a plurality of possible positions on the upper and lower plates **32,34**.

Referring to FIGS. **5** and **6**, there are shown cross-sectional views of the portable rescue tool **10**. The housing **22** comprises a top section **48** which is secured to the upper plate **32**, a bottom section **50** which is secured to the lower plate **34**, and a middle section **52** which is secured to the pair of spacers **36** along with the first handle **14**. The rotary switch **16** is secured to the upper and lower plates **32,34** through the middle section **52** of the housing **22**. The rotary switch **16** is used to select the mode of the low speed, high torque output (i.e. either opening or closing the spreading and/or cutting arms). The rotary switch **16** operates by connecting (or not connecting) the DC motor **24** to an external DC power source (not shown). Depending upon the position of the rotary switch **16**, DC power is provided to the terminals of the DC motor **24** so as to energize the DC motor **24** and thereby provide a high speed, low torque output in one of two rotational directions. The rotary switch **16** is typically a three-positional switch with a first position being a clockwise (CW) direction position, a second position being a counter-clockwise (CCW) direction position, and a third position being a neutral or off position. The DC motor **24** is typically a self-contained, explosion-proof electric motor having an output sprocket **54** mounted to its rotor shaft.

The gear reduction assembly **26** has an input sprocket **56**, an output sprocket **58**, and a gear assembly **60** all designed for decreasing the speed and increasing the torque of the DC motor output. The gear reduction assembly **26** also has brake assembly **62** that is typically a fail-safe, electrically-off brake which is connected in parallel across the terminals of the DC motor **24**. Thus, whenever the DC motor **24** is not provided with DC power, the brake assembly **62** is engaged. The first chain **28** operatively couples the output sprocket **54** of the DC motor **24** and the input sprocket **56** of the gear reduction assembly **26**.

The actuator assembly **20** has an input sprocket **64** and a gear assembly **66** designed for decreasing the speed and increasing the torque of the gear reduction assembly output. The second chain **30** operatively couples the output sprocket **58** of the gear reduction assembly **26** and the input sprocket **64** of the actuator assembly **20**.

The gear assembly **66** comprises a splined shaft **68** onto which the input sprocket **64** is mounted, a sun gear **70** spline coupled to the splined shaft **68**, a plurality of planet gears **72** gear coupled to the sun gear **70**, a plurality of planet shafts **74** corresponding to and associated with the plurality of planet gears **72**, a splined carrier **76** operatively engaged with the plurality of planet shafts **74**, a sun gear **78** splined coupled to the splined carrier **76**, a plurality of spindle gears **80** gear coupled to the sun gear **78**, upper and lower fixed ring gears **82** and **84** gear coupled to the plurality of spindle gears **80** and having the fixed ring gear lugs **40** formed as a part thereof, and a movable ring gear **86** gear coupled to the plurality of spindle gears **80** and having the movable ring gear lugs **38** formed as a part thereof. As previously mentioned, spreading and/or cutting arms (not shown) are attached to the movable ring gear lugs **38** and the fixed ring gear lugs **40** so as to perform rescue tool functions. It should be noted that the total gear reduction from the output of the DC motor **24** to the output of the actuator assembly **20** (i.e. the opening or the closing motion of the spreading and/or cutting arms) is typically 6000:1.

The actuator assembly **20** is rotatably mounted to the upper and lower plates **32,34** with a snap ring **88** and retaining rings **90**, respectively. As previously mentioned, the clutch mechanism **42** is utilized to orient and mount the actuator assembly **20** in a plurality of possible positions on the upper and lower plates **32,34**. Also as previously mentioned, the clutch mechanism **42** comprises the clutch housing **44** and the clutch handle **46**.

The clutch housing **44** is fixedly secured to the upper plate **32**, and a first friction disk **92** is fixedly secured to the clutch housing **44**. A second friction disk **94**, disposed directly beneath the first friction disk **92**, is keyed to the actuator assembly **20** through the upper fixed ring gear **82**. A third friction disk **96** is disposed directly beneath the second friction disk **94** and rests upon a spacer **98**. The spacer **98** is biased upwards against the third friction disk **96** by a

Bellville spring **100**, which is supported by a threaded shaft **102**. The threaded shaft **102** passes through the center of the clutch housing **44** and engages the clutch handle **46**. Thus, the second friction disk **94**, and hence the upper fixed ring gear **82** and the entire actuator assembly **20**, may be fixed into position by tightening the second friction disk **94** between the first and second friction disks **92,96** by tightening the clutch handle **46** down along the threaded shaft **102**. Alternatively, the actuator assembly **20** may be repositioned, with respect to the upper and lower plates **32,34**, by loosening the clutch handle **46** up along the threaded shaft **102** thereby relieving the friction between all of the friction disks **92,94,96** and allowing the actuator assembly **20** to be rotated within the upper and lower plates **32,34**. It should be noted that the threaded shaft **102** is kept from rotating by a dowel pin **104** that is keyed to the clutch housing **44**.

From the foregoing detailed description, it can be readily understood that the clutch mechanism **42** allows high torque spreading and/or cutting motion that is produced by the portable rescue tool **10** to be oriented in a plurality of possible directions with respect to the portable rescue tool **10**. This clutch mechanism **42** operates by simply loosening a clutch handle **46**, positioning the actuator assembly **20** within the upper and lower plates **32,34**, and then tightening the clutch handle **46**. It should be noted that a thrust bearing **106** is disposed between the clutch handle **46** and the clutch housing **44** for assisting in turning the clutch handle **46**.

With the present invention portable rescue tool **10** now fully described, it can thus be seen that the primary objective set forth above is efficiently attained and, since certain changes may be made in the above-described portable rescue tool **10** without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A portable rescue tool for providing low speed, high torque output motion in a plurality of possible directions with respect to said portable rescue tool, said portable rescue tool comprising:

an actuator assembly having output means for providing low speed, high torque output motion;

a frame assembly having at least one support member extending therefrom, said at least one support member being adapted for receiving said actuator assembly; and

a clutch mechanism for securing said actuator assembly to said at least one support member in a plurality of positions so as to orient said low speed, high torque output motion in a plurality of directions with respect to said frame assembly.

2. The portable rescue tool as defined in claim **1**, further comprising a motor, said motor being mounted to said frame assembly.

3. The portable rescue tool as defined in claim **2**, wherein said motor is a portable DC motor.

4. The portable rescue tool as defined in claim **1**, further comprising a gear reduction assembly, said gear reduction assembly being mounted to said frame assembly.

5. The portable rescue tool as defined in claim **4**, wherein said gear reduction assembly is operatively coupled to said actuator assembly.

6. The portable rescue tool as defined in claim **1**, wherein said clutch mechanism comprises a clutch housing and a friction disk assembly, wherein a first friction disk is affiliated with said clutch housing, wherein a second friction disk is affiliated with said actuator assembly, and wherein said first friction disk and said second friction disk are spring biased toward each other.

7. A portable rescue tool for providing low speed, high torque output motion in a plurality of possible directions with respect to said portable rescue tool, said portable rescue tool comprising:

an actuator assembly having output means for providing low speed, high torque output motion;

a frame assembly having at least one support member extending therefrom, said at least one support member being adapted for receiving said actuator assembly;

a motor mounted to said frame assembly, said motor being operatively coupled to said actuator assembly; and

a clutch mechanism for securing said actuator assembly to said at least one support member in a plurality of positions so as to orient said low speed, high torque output motion in a plurality of directions with respect to said frame assembly.

8. The portable rescue tool as defined in claim **7**, wherein said motor is a portable DC motor.

9. The portable rescue tool as defined in claim **7**, further comprising a gear reduction assembly, said gear reduction assembly being mounted to said frame assembly, said gear reduction assembly being interposed between said motor and said actuator assembly for operatively coupling the same.

10. The portable rescue tool as defined in claim **7**, wherein said clutch mechanism comprises a clutch housing and a friction disk assembly, wherein a first friction disk is affiliated with said clutch housing, wherein a second friction disk is affiliated with said actuator assembly, and wherein said first friction disk and said second friction disk are spring biased toward each other.

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